ENERGY to care

Greater efficiency supports patient care.

Optimizing Chilled Water Plant Performance

All ECM content was independently developed and reviewed to be vendor-, product-, and service provider-neutral.

DESCRIPTION

The chilled water (CHW) plant is often the most energy and cost intensive portion of a facility. When trying to reduce energy use, the CHW plant is a great starting point. CHW optimizations can range from adjusting setpoints to full-scale plant renovations and advanced software controls integration.

PROJECT TALKING POINTS

- Due to the high energy use/cost intensity of a CHW plant, CHW optimization paybacks are often under 5 years.
- Optimization not only includes energy upgrades, but reliability upgrades. A more reliable plant will lead to less reactive maintenance, longer equipment lifespans, and a safer environment of care.
- Modern plants generally have quicker paybacks than older plants, due to less infrastructure changes needed.

TRIPLE BOTTOM LINE BENEFITS

Cost Benefits: An optimized CHW plant uses less energy to chill water, reducing energy costs. Additional CHW capacity is freed-up, reducing the need for expensive additions. Finally, mechanical equipment will experience less wear, reducing equipment replacement frequency and costs.

Environmental Benefits: Decreased energy usage in the chilled water plant directly corresponds to lowered carbon emissions. Longer mechanical equipment life of plant components means that less metal is scrapped or sent to landfills.

Societal Benefits: Chilled water plant optimization reduces energy costs for a healthcare facility and enables more capital to be allocated towards quality of medical care. Reducing harmful power plant emissions reduces the amount of health impacts due to poor air quality.

PURCHASING CONSIDERATIONS

Prior to CHW optimization, consider existing plant conditions. Consider mechanical upgrades on older plants for considerable performance increase. Modernized chilled water plants will feature variable-frequency drives (VFDs) on pumps, compressors, and cooling tower fans. This allows for greater flexibility in plant operation and more opportunity for optimization.

The controls system for the CHW plant will significantly impact the optimization; better performance is achieved when all equipment points in the plant are writeable from the BAS. When systems in a chiller plant are pre-programmed, this means that they are not controllable from the global BAS. Pre-programmed, or "packaged" equipment is controlled using pre-installed logic and will require the services of the supplier to modify.

HOW-TO

1. The CHW plant operators, facility owners, controls vendors, and a commissioning agent should meet to discuss the existing conditions of the plant, possible retrofits, current operating procedures and limitations. Be sure to involve an experienced commissioning agent.
2. The commissioning agent and plant operators will observe trends and plant performance to determine if any specific conditions lead to excessive energy consumption or instability. Such conditions include:
    a. Outdoor air temperature (OAT) extremes
    b. Additional equipment stage-up or stage-down
    c. Transition from free cooling to mechanical cooling
3. Some conditions which upset performance and common engineering strategies to address these issues include:
    a. Temperature extremes-
        i. Attempt to reduce load during high temperatures
        ii. Look for flow imbalance in primary-secondary configurations
    b. Transition from free cooling to mechanical cooling-
        i. Slow down the transition to allow equipment time to respond
        ii. Work with controls technician to improve control stability
    c. Equipment stage-up and stage-down-
        i. Alter setpoints to bring equipment online and offline at more appropriate times
        ii. Reduce the speed of equipment staging to allow the system time to respond
4. Check sensors for issues. A small discrepancy can cause significant error in operation and calculations for optimization work.
5. Consider resets.
    a. CHW reset – based on OAT or demand
    b. CW reset – based on outdoor air (OA) Dew Point
        i. Save 1.5% per degree of reset on each
    c. Distribution pump pressure reset- based on most remote Chilled Water Valve (CHWV) position
6. Ensure the cooling towers are operating in "parallel"
    a. The more towers running, the greater surface area and colder the condenser water
        i. Lower condenser water temperature reduces the amount of work the compressor must perform to transfer heat from the evaporator to the condenser
    b. With all towers enabled, fan power will be reduced
7. In primary-secondary loop systems, watch for the following:

    a. If the chillers are not loaded but the loop temperature is too high, look for an imbalance in the de-coupler.
        i. Many plants are installing check valves in the de-coupler to prevent “runaway plant” syndrome.
        ii. Make sure secondary flow is less than or equal to primary flow.
    b. If the secondary loop flow exceeds primary, the supply temperature will be polluted by return water.
8. Consider installing a controls vendor or third-party optimization software.
    a. Controls vendors often have plant optimizer software. If not, third party companies exist which can integrate with existing equipment
    b. These packages calculate ideal setpoints to run the plant at the maximum efficiency.
9. After the plant’s additions are setup properly, the commissioning agent will write the optimization sequence logic for the chilled water plant. The written sequence will contain all items addressed in the scope of the project.
10. Once the written sequence is completed, the commissioning agent will work with the plant controls vendor to implement the program. A controls technician will program the plant controllers to operate via the modified sequence. If optimization software is used, it will be installed.
11. The commissioning agent will then perform a functional test of the chilled water plant to ensure that the implemented sequence is operating according to the agreed upon sequence.

REGULATIONS, CODES AND STANDARDS, POLICIES

- **ASHRAE 90.1 2019– Energy Standard for Buildings**
- **ASHRAE 100-2018 – Energy Efficiency in Existing Buildings**

CROSS REFERENCES

LEED v4. For BD + C: Healthcare

Water Efficiency

- Indoor Water Use Reduction- Requirement
- Indoor Water Use Reduction- Credit
- Cooling Tower Water Use- Credit

Energy and Atmosphere

- Enhanced Commissioning- Credit
- Optimize Energy Performance- Credit

LEED v4. For Operation & Maintenance: Existing Buildings

- Water Efficiency
    - Prerequisite- Indoor Water Use Reduction
    - Prerequisite- Building-Level Water Metering
    - Credit- Cooling Tower Water Use
    - Credit- Water Metering

- Energy and Atmosphere
    - Prerequisite- Energy Efficiency Best Management Practices
    - Prerequisite- Minimum Energy Performance
    - Prerequisite- Building-Level Energy Metering
    - Credit- Existing Building Commissioning- Analysis
    - Credit- Existing Building Commissioning- Implementation
    - Credit- Ongoing Commissioning
    - Credit- Optimize Energy Performance
    - Credit- Advanced Energy Metering

RESOURCES

ASHE - Reducing Operational Costs through Energy Efficiency

ASHRAE - Advanced Energy Design Guide for Hospitals

NREL - Chilled Water Assessment Guidelines